

Review

Probiotic potential of lactobacillus strains in human infections

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Probiotics means “for life”. Probiotics are naturally occurring beneficial organisms that aid in digestion and inhibit disease-causing bacteria in the intestine. Due to the beneficial impact of microorganism used as Probiotics; during the last decades progressive attention has been focused on biological and molecular characterization and improvement of such microbes during the last decades. Probiotics in the strictest sense, refers to lactic acid producing bacteria Most data accumulated so far have related that lactic acid bacteria are major organisms, which that when given orally will pass through the strong acid of the stomach and the low surface tension of bile and colonize in the intestine, which is their normal habitat. Lactic acid bacteria mainly include *Lactobacilli* and *Bifidobacteria*. Various studies have indicated that *lactobacillus* species may have a positive influence on the intestinal flora of human, alleviate lactose intolerance, have hypocholesterolemic effect, stimulate immunity and have anti-colon cancer effects, Crohn’s disease and candidiasis infections. Interest in the field of probiotics has bloomed in recent years and considering the above impressive list of potential health-promoting benefits, it is not surprising that there continues to be considerable interest in the use of probiotics as biotherapeutic tool to improve the diseased conditions of humans although much remains to be elucidated.

Key words: Probiotic, friendly bacteria, microorganisms, lactic acid bacteria, *Lactobacilli*, *Bifidobacteria*, biotherapeutic tool.

INTRODUCTION

Probiotics

Probiotics are the viable microorganisms, which upon digestion exert health-promoting effects on host. Living organisms, which upon ingestion in certain numbers exert health benefits beyond inherent basic nutrition (Guarner and Schaafsma, 1998; Reid et al., 2003). Some researchers define them as “the microbial supplement that beneficially affects the host animal by improving its intestinal microbial balance” (Fuller et al., 1992). For bacteria to give their probiotic effects, they must be able to tolerate the intestinal acidic pH and the bile acids of intestine (Gibson et al., 2000). They must arrive in the

sufficient amount in the gastrointestinal tract, so that they produce beneficial effects on the host health (Fuller, 1992).

The use of microorganisms in fermentation of various foods is one of the oldest methods for producing and preserving food. The primary use of Probiotics is to restore the normal flora in the intestine that is often eliminated due to the poor diet. Probiotics uses nutrients of pathogenic organisms; make their host environment less favorable by decreasing the pH of the intestines and vagina by secreting acetic acid or lactic acid. It includes several species of lactic acid bacteria (Mel’nikova et al., 1993).

FIRST CONCEPT OF PROBIOTICS

The first concept of probiotics was evolved by a father of immunology, Elie Metchnikoff, the noble prize winning

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Russian Immunologist. He demonstrated in 1908 that the reason behind the long life of Bulgarian peasants was due to the consumption of milk products fermented with the bacillus which had decreased the toxicity of colonic micro flora thus established positive influence of colon micro flora (Metchnikoff, 1908). His idea had generated an interesting approach about the role of gut micro flora. Today, many researchers are investigating the potential health benefits of the probiotic strains (Mercenier, 2003; Reid et al., 2003).

LACTIC ACID BACTERIA (LAB)

One of the most significant groups of probiotic organisms are lactic acid bacteria (LAB). Lactic acid bacteria are gram positive, heterotrophic, usually non-motile, non-sporulating and produce a main product known as lactic acid. These organism lack many biosynthetic capabilities, thus have complex nutritional requirements for amino acids and vitamins, due to these complexity, they are abundant only in communities where these requirements can be provided. Their communities are often associated in intestinal tract (Henriksson et al., 1991), in oral cavities, decaying of plants and animals matter, feces, vegetables, fruits etc. Lactic acid bacteria have been reported to be useful as a health adjunct and are commonly added to food as the delivery mechanisms (Fuller, 1992).

The LAB's mainly include *Lactobacilli* and *Bifidobacteria*. *Lactobacilli* and *Bifidobacteria* maintain a healthy balance of intestinal flora by producing organic compounds—such as lactic acid, hydrogen peroxide and acetic acid—that increase the acidity of the intestine and inhibit the reproduction of many harmful bacteria (Tannock, 1997; Kawase, 1982). These bacteria are spread through out the world, as they are present in the dairy products such as milk, yogurt, cheese, fruits, vegetables, meat, soil, humans and animal body. These are frequently used as starters in manufacture of fermentation of dairy products, infant's food, and pharmaceutical products.

CONDITIONS HELPED AND CURED BY LACTOBACILLUS SPECIES

Prevention of candidiasis

Candidiasis is an infection caused by yeast like fungus called candida. It can infect the mouth, vagina, skin, stomach and urinary tract. Approximately 75% of women will get candidiasis of the vagina during their life time and 90% of all people with HIV/AIDS develop candida infections. Candidiasis occurs when there is a build up of candida which causes creamy white patches in the mouth or throat, cracks at the corners of the mouth, skin rashes, patches and blisters in the groin, under the breast, between

fingers and toes vaginal itching and irritation with a curd-like discharge (Hilton et al., 1992). Several species of *Lactobacillus rhamnosus* are able to eliminate the vaginal candida infections. Use of yogurt containing *Lactobacillus acidophilus* reduces the occurrence of vaginal candidiasis (Hilton et al., 1992).

PREVENTION OF CROHN'S DISEASE (CD):

Crohn's disease (CD) is a chronic condition characterized by patchy areas of inflammation and open sores or ulcers along the innermost layer of the digestive tract. These lesions can develop any where in the mouth to anus. Majority of the cases involve the small intestine or the first part of the large intestine. And between these patches of inflammation and ulceration there remain stretches of normal, healthy tissue. CD is closely related known as ulcerative colitis (UC). Both CD and UC are considered inflammatory bowel diseases (IBD) (Podolsky, 2003). Researchers have made attempts on CD patients to control the severity of this disease by the administration of probiotics, *Lactobacillus* species (Madsen, 2001). It has been shown that the species of *Lactobacilli* are able to control the ulcers in the intestines called Crohn's disease (Schultz et al., 2004).

PREVENTION OF LACTOSE INTOLERANCE

Lactose intolerance is the impaired ability to digest lactose (the naturally occurring sugar in milk). The enzyme lactase is needed to digest lactose and a few children and many adults do not produce sufficient lactase to digest the milk sugar. The condition is rare in infants. Only one-third of the population world-wide retain the ability to digest lactose into adulthood. Most adults of Asian, African, Middle Eastern and Native American descent are lactose intolerant. Studies have shown that lactose tolerance, digestion and lactose transport were improved by ingestion of unfermented milk with *L. acidophilus*, as this specie has shown better lactose transport in lactose intolerant subjects (Mustapha et al., 1997). When intolerant patients were given the unfermented milk supplemented with *L. acidophilus* strains improves the lactose digestion and tolerance (Mustapha et al., 1997).

L. acidophilus strains are the source of lactase, the enzyme needed in the digestion of milk products, which lacks in lactose intolerant people (McDonough et al., 1987). Some times it also inhibits the fermentation of lactose and thus reduces the symptoms of lactose mal-digestion (Scharafisma, 1993). Another study has shown that milk fermented with *L. acidophilus* and *L. casei* of human origin are good therapeutic tool for lactose digestion in different lactose intolerant subjects, as subjects have shown better tolerance to milk with

Lactobacillus species over regular milk without any probiotic strains (Gaon, 1995).

PREVENTION OF GASTRIC INFECTION (*Helicobacter pylori*)

Probiotic strains of *Lactobacilli* have been used for effects on *Helicobacter pylori* infections. Regular ingestion of milk based *L. johnsonii* La1 fermented product resulted in a significant reduction of infection levels of *H. pylori* (Michetti et al., 1999) when measured by the ¹³C-urea breath test (UBT) (Gotteland and Cruchet, 2003). Ingestion of yogurt containing *L. acidophilus* La5 and *Bacillus lactics* Bb 12 showed positive reduction in UBT values, gastric activity (Wang, et al. 2004). While *L. rhamnosus* GG supplementation beneficially affected *H. pylori* therapy-related side effects such as bloating, diarrhea, nausea and taste disturbances (Armuzzi et al., 2001). A significant reduction in gastric ornithine decarboxylase activity and UBT values was reported by ingestion of *L. brevis* (CD2) species in *H. pylori* infection (Linsalata et al., 2004). *L. salivarius* was proven to have greatest inhibitory effects on the proliferation and highly effective tool in terminating the *H. pylori* as it produced high amount of lactic acid, which was an inhibitory agent against *H. pylori* colonization (Drisko et al., 2003). It was also observed by the *L. casei* reduced the infection of *H. pylori* (Cats et al., 2003). *L. gasseri* OLL2716 (LG21) showed significant improvement in both suppressing *H. pylori* and reducing gastric mucosal inflammation (Ichiko et al., 2001). *L. acidophilus* effectively reduced the attachment sites of *H. pylori* in the cell wall and has been used as a curing therapy against the infection of *H. pylori* (Mrda et al., 1998).

ESTABLISHMENT OF IMMUNE SYSTEM

Friendly bacteria *L. acidophilus* are able to gobble up the mutant cells, invaders, metabolic trashes. The functions of immune system is to provide a protection against diseases by providing antibodies, LAB destroyed the mutant cells which when present in great amounts are transformed in the tumor or cancerous cells. Lactic acid bacteria have potential to produce B-lymphocytes or B cells; by which they recognize foreign harmful particles (De Simone et al., 1993; Schiffrin et al., 1995).

Several studies have demonstrated that *L. acidophilus* is able to boost the immunity of host by producing the strong colonies in the intestinal tract, so that pathogenic bacteria were not able to create any destruction in the host body (Perdigón et al., 1993; De Simone et al., 1993). *L. acidophilus* may also improve immunity by increasing the amount of antibody secretor cells in the intestinal lining and interferon production (Halpern et al., 1991; Cunningham et al., 2000).

PREVENTION OF COLORECTAL CANCER

Colorectal cancer is the cancer of colon and rectum. It is the second most commonly diagnosed cancer in American population. Colorectal cancer develops in the digestive system, which is the main machinery of human body for processing of food for energy and eliminating the solid waste. The colon is the first part of large intestine absorbs water and nutrients from food and serves as a storage place for solid waste. The waste moves from the colon into the rectum the final 6 inches part of large intestine, where it passes out of the body through the anus. Cancers affecting either of these organs are called colorectal cancer.

Most of the colorectal cancers arise from polyps that begin growing on the inner lining of the colon or rectum. Studies showed that fermented dairy products, calcium effectively reduce the colorectal cancer (Kampman et al., 1994). Several researchers suggested that lactic acid bacteria are involved in direct reduction of enzymes that converts procarcinogens into carcinogens either by utilizing nitrates or by reducing the levels of secondary bile salts (Fernandes, 1990). The changes in enzymatic activity, which are involved in mutagenic activity of procarcinogens, were also observed in *L. acidophilus* (Marteau et al., 1990).

The risk of colorectal cancer was reduced by *L. casei*, which reduces the level of mutagens in stool (Kato et al., 1981) and stimulate the immune system, in protection against some carcinogens (Marteau et al., 1990). There is lower chance of tumors in those exposed to a carcinogen, in the presence of *L. casei* sub species *L. rhamnosus* compared to subjects exposed to the carcinogen without the benefit of these strains (Golden, 1996).

PREVENTION OF HYPERCHOLESTEROLEMIA

Cholesterol is a soft waxy substance that is a natural component of the fats in the bloodstream and in all the cells of the body although cholesterol is an essential part of a healthy body, high levels of cholesterol in the blood is known as Hypercholesterolemia. When cholesterol level is high in the blood stream, it creates sticky deposits known as plaque along the artery walls. Increased serum cholesterol highly correlates with the incidence of hypercholesterolemia and coronary heart diseases. Several studies have suggested that if the normal cholesterol level is above 1 mmol than the risk of coronary heart diseases increases approximately 35% higher while the rate of coronary death was 45% higher (Lipid Research Clinics Program, 1984). Even small reduction in serum cholesterol of 1% by *L. acidophilus* was found to reduce the risk of coronary heart diseases by 2 to 3% (Manson et al., 1992).

One beneficial effect of human consumption of LAB is

reduction in serum cholesterol (Pereira and Gibson, 2002) and *L. acidophilus* has the potential of reducing risk of coronary heart disease by 6 to 10% by reducing the serum cholesterol (James et al., 1999). The reduction in hypercholesterolemic effects in humans was demonstrated 1963 and in 1974, when subjects were treated with milk fermented with *Lactobacilli* (Mann, 1947). Various attempts have shown that species of *Lactobacilli* were capable of lowering serum cholesterol and reducing the severity of hypercholesterolemia either by lowering total elevated serum cholesterol or reducing low density lipoproteins LDL (Anderson and Gilliland, 1999).

The *in vitro* cholesterol reduction was obtained by some of the *Lactobacillus* species from its coprecipitation with deconjugated bile salt (Klaver and R Vander, 1993). One possible mechanism that was proposed by some researchers was assimilation (uptake) of cholesterol by the cells of *L.s acidophilus* during their growth (Buck, 1994; Gilliland, 1985). Another beneficial mechanism for removal of cholesterol is the hydrolysis of bile salts. This action was dependent on the presences of enzymes known as Bile Salt Hydrolase (BSH). Bile salt hydrolase's is the part of the bile salt metabolism in humans and dependent on the intestinal micro flora. When the bile salt deconjugates, it enhances the excretion of bile salts through feces. The enzyme known as Bile Salt Hydrolase (BSH) catalyzed the hydrolysis of conjugated bile acids into simple amino acids residue and the bile acids. Another mechanism studied by *Lactobacillus* strains for reduction in elevated levels of serum cholesterol was observed in fermented milk with EPS (exopolysaccharides) producing lactobacilli (Cerning and Marshall, 1999). These strains have significant ability of lowering serum cholesterol.

Conclusion

Interest in the field of probiotics has bloomed in recent years, molecular biology have provided beneficial tool to assess the real probiotic behavior of a specific strain (Tannock, 1997). The ability of a specific probiotic strain to survive and reproduce in the hostile environment of the gut is the most relevant feature to be checked during the selection procedures. Further development of probiotic products requires a refinement of these criteria. A deeper understanding of the molecular mechanisms that are used by bacteria to tolerate and persist in the harsh environments of the upper part of our gastrointestinal tract.

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